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Abstract

Most impact studies of agricultural technologies use economic models, with little direct attention being paid to the actual impact on the lives of resource-poor farmers. This paper uses a social impact assessment (SIA) framework to examine the level of adoption and impact of soybean on farm households in Nigeria based on a survey of 203 households in Benue State. The results show that the status of soybean has changed from a traditionally male controlled minor export crop, to one of the most important crops cultivated by the majority of male and female farmers. More women have become involved in soybean production as improved varieties and household utilization technologies have become readily available. The new varieties have been widely adopted, beginning with 9% of farmers in 1989 reaching over 75% in 1997, and these now occupy about 30% of the total soybean land area. Analysis conducted with a Tobit model showed that farmers' socioeconomic characteristics and farmers' assessment of the attributes of improved varieties were both important in explaining their adoption behavior. The adoption of soybean has had a clear positive impact on household income generation and distribution, material welfare, human capital development, gender relations, resource use, social equity, and other social processes in the community. Many innovations in soybean utilization have been adopted, to the extent that soybean has become a staple food. The results further showed that the nutritional status of children was significantly better in soybean producing/using households than in those that did not use soybean. A multivariate analysis of the nutritional status of children showed that soybean consumption, income earned from soybean, and women's production of soybean had significant positive impacts on both the short- and long-term nutritional status indices. The results of this study provide a strong case for the promotion of soybean as a cheap solution for malnutrition and a means of poverty alleviation for poor people.

Key words: Farmers' welfare, social impact assessment (SIA), soybean, Nigeria, sub-Saharan Africa

Introduction

The goal of agricultural research centers such as the International Institute of Tropical Agriculture (IITA) is to generate technologies for improving productivity, farmers' welfare, and household nutritional status. In recent years, there has been growing concern to assess the impact of agricultural research at farmers' level to determine who benefits from technological change and in what specific ways at both the small-scale and societal levels. Yet, the majority of studies on the impact of agricultural research have been carried out within conventional economic frameworks such as benefit-cost analysis, economic surplus models, and economic efficiency estimation (Norton and Davis 1981; Jahnke et al. 1987; Adesina and Zinnah 1992; Alston et al. 1995; Walker and Crissman 1996; Kormawa 1996; Coulibaly et al. 1998).

Within such economic frameworks, little or no attention is given to the actual social impact of technology, that is, the impact of technology on the lives of people, their welfare, their nutritional status, their gender relations, and other social processes in the community. Impact on the lives of resource-poor farmers is probably the most functional benefit of agricultural technologies, and the dominant preoccupation of stakeholders (Jahnke et al. 1987; Collinson and Tollens 1994). There is thus a strong need to focus on the social impact of agricultural technologies in sub-Saharan Africa where social concerns are higher and more pressing than anywhere else in the world (Derman and Whiteford 1985; Demery et al. 1993).

As an instrument of user-oriented and people-centered research, the social impact assessment (SIA) framework has been developed using a more holistic and comprehensive approach in response to the limitations of the traditional economic impact analysis. SIA represents an effort to analyze the real, or potential, impact of technologies upon specific groups of people. It requires analysis of changes that occur in the lives of people as a result of adopting innovations or new policy interventions. It helps to determine how far a technology has been successful in meeting social and economic objectives, and how well such technologies satisfy the needs and aspirations of households or other larger social units in the target population (Carley and Derow 1980; Campbell 1990; Cernea 1991). SIA findings can also help to improve the efficiency of the spectrum of technology development, its targeting and its transfer in order to amplify the benefits accessible to a greater number of people, and presumably to prevent, or at least mitigate potential adverse consequences.

This paper is based on an *ex-post* impact case study on the introduction of soybean production and utilization technologies to Nigeria. Soybean has been variously

described as a “miracle bean” or a “golden bean” because it is a cheap, protein-rich grain. It contains 40% high quality protein, 20% edible vegetable oil, and a good balance of amino acids (Singh et al. 1987; Weingartner 1987) and has, therefore, tremendous potential to improve the nutritional status and welfare of the families of resource-poor farmers. Soybean can also contribute to the enhanced sustainability of intensified cropping systems by improving soil fertility through nitrogen fixation, permitting a longer duration of ground cover in the cropping sequence, and providing useful crop residues for animal feed.

However, soybean is a relatively new crop in Africa. Until recently, it was seen as being appropriate only for large-scale commercial farming where the crop can be used for industrial processing and for livestock feed (Shannon et al. 1995). A commonly held view is therefore that soybean is of little or no importance in sub-Saharan Africa, as the crop will not bring benefit to small-scale farmers who form the bulk of the farming community.

Development of improved soybean varieties and utilization technologies

Soybean may have been introduced to Nigeria as early as 1908, but its cultivation as a crop can be attributed to the introduction of the Malayan variety in 1937 by British colonial officers in Benue State (Singh et al. 1987). Until recently, the Malayan variety was virtually the sole variety grown by farmers. This variety is low yielding, susceptible to bacterial diseases and is late maturing (Smith et al. 1995). The latter characteristic exposes soybean to pod shattering due to the desiccating action of the seasonal Harmattan wind. The expansion of the crop was limited by the lack of suitable varieties. Moreover, most soybean varieties could not nodulate in association with the native rhizobia indigenous to African soils and the seed quickly lost viability, which made it difficult for farmers to store it until the next cropping season (Dashiell et al. 1987).

Over the last two decades, IITA has made substantial efforts to improve the productivity of the crop by developing high yielding, early maturing varieties capable of nodulating in association with local rhizobia, and possessing other good agronomic traits (IITA 1994). Improved soybean varieties released in Nigeria include TGx 849-313D, TGx 1019-2EN, TGx 1019-2EB, TGx g1447-2E, TGx 536-02D, TGx 306-036C, TGx 1485-1ED, and TGx 1440-1E (IITA 1994). The identification of seed collected from farmers revealed that farmers were planting the following varieties: M351, Samsoy 1 and 2, TGx 536-02D, TGx 923-1E, TGx 1440-1E, TGx 1448-2E, TGx 306-036C, and TGx 1485-1ED.

These varieties were introduced to farmers over a range of time following different channels. Early attempts to diffuse improved varieties started in the late 1970s

with the introduction of the variety Genyi by the Department of Agriculture. It was not until the late 1980s that other improved varieties became available. In the early 1980s, the varieties Samsoy 1 and Samsoy 2 were released and introduced to farmers. In the late 1980s, the Benue State Agricultural and Rural Development Authority (BNARDA)—the State extension services—introduced the variety TGx 536-O2D developed by IITA for mass adoption. Recently the variety TGx 923-1E was also introduced, but at the time of our study, it had not reached a stage of mass adoption. The variety TGx 1440-1E was still at the stage of adaptive research in the northern zone of Benue State.

The focus of the adoption study is, therefore, restricted to the most popular varieties M351, Samsoy 1 and 2, TGx 536-02D, and TGx 923-1E. We considered TGx 536-02D and TGx 923-1E as improved varieties because they were introduced through the formal diffusion channel, and could therefore be considered as an innovation. Moreover, the formal release and diffusion process for these varieties had ended and this fact made it possible to study the process, pattern, and extent of their adoption by farmers.

Following the development and introduction of improved varieties, many food recipes using soybean were found to be highly acceptable to Nigerians, including their incorporation into traditional local dishes (Osho and Dashiell 1998). Substantial efforts were made to promote soybean utilization technologies among rural and urban households. National research and extension personnel in many African countries have been trained in soybean production, processing, and utilization techniques. In Nigeria, more than 47 000 persons, including about 30 000 women, have been trained in the production and potential utilization of soybean in their families' diet.

Need for adoption and impact studies

Despite several years of soybean research and diffusion in Nigeria, there remains a dearth of empirical information on the level and extent of its adoption and utilization by resource-poor farmers. No systematic study has investigated the actual impact of soybean on farmers' households and rural communities. The objective of this paper is to assess the real impact of soybean on the lives of small-scale farmers in Benue State, Nigeria. In particular, the paper examines the different gender roles in soybean production, the levels and factors influencing farmers' adoption of improved soybean varieties and utilization innovations, the impact of soybean production on farmers' income generation and distribution, their use and allocation of resources, their household food consumption, nutritional status, welfare, and other relevant social processes in the community.

Methodology

Social impact assessment (SIA) framework

Morgan (1985) suggested three areas that need to be examined in any social impact assessment. These are sociocultural feasibility, spread effects, and distributional impact. Sociocultural feasibility should ascertain that the assessment is based on an accurate understanding of the social organization of productive activities, that is, it should find out how the intended beneficiaries have access to, make use of, and exercise control over natural and other productive resources available in the area. Spread effects refer to the likelihood that the new technology introduced to the initial target group will be diffused among others. Distributional impact is concerned with the differential impact of technology, and the distribution of benefits/burdens upon different categories of people, that is, it should find out who benefits from technology and in what ways.

The framework used in this study is based on the technology diagnostic-diffusion-adoption-impact continuum. The entrance point for SIA is accurate diagnosis and understanding of the social organization of productive activities. Drawing from Feldstein and Poats (1989) and McCorkle (1994), we used gender analysis in an agricultural framework. This holistic, context-specific, and problem-driven framework has been shown to be useful in the understanding of the social organization of productive activities, intrahousehold dynamics, decision-making, incentives, resources, and constraints within a farming system (Moock 1986). In particular, it permits the analysis of the socioeconomic and demographic characteristics of the population, and helps to find out how the intended beneficiaries have access to, use, and control the productive resources available in the area; and how the division of roles and responsibilities may affect intended beneficiaries' interest in the production of soybean.

The second component of the framework is the analysis of the technology diffusion and adoption process. The technology diffusion process involves analysis beyond the current adoption status and documents the history, trends, patterns, and prospects of technology adoption. Adoption studies have been seen as an important tool for measuring and assessing the impact of agricultural technologies (CIMMYT 1993; Feder and Umali 1993; Rogers 1995). Technology adoption brings potential impact at farm household level. Analysis of the adoption process also permits investigation of the categories of farmers that have benefited most from a particular technology. In this study, adoption is defined as the current use and intensity of use of improved soybean varieties and utilization technologies. It is hypothesized to be a function of the socioeconomic characteristics of farmers (gender, age, education, income, household size, labor availability, experience in soybean production, etc.), institutional and sociostructural factors (extension

contact, village location, access to market, social organizations), and farmers' assessment or perceptions of the characteristics of soybean varieties (yield, grain color and size, maturity time, resistance to shattering, resistance to pests and insects, and performance on poor soils).

Thirdly, SIA is concerned with impact analysis, that is, finding out how far the introduction of an improved technology has been successful in meeting socioeconomic objectives, and how well improved agricultural technologies have satisfied the needs and priorities of households and other units in the target population. Social impacts are changes that have occurred for an individual farmer at household or farm level or in the community at large as a result of the adoption of soybean. At the household level, important impact indicators include farmer's income and income distribution, intrahousehold gender relations, allocation and control of resources, material welfare, human capital development, household food security, and nutritional status. At the farm level, impact indicators include increasing outputs (yields), land-use expansion and intensification practices, input use, crop substitution, and varietal replacement. The impact of soybean adoption can also be extended beyond the farm household to the community. At the community level, it is hypothesized that the adoption of soybean has had an effect on attitudes and values, labor, market development, social equity, innovativeness, and the potential sustainability of soybean production.

Study zone and population

The study was carried out in the northern zone of Benue State, where soybean is most extensively grown. Known as the home of soybean, Benue State has the longest history of soybean cultivation in Nigeria. It is estimated that the state accounts for over 70% of soybean production (BNARDA 1995). The state lies in the east of the country in the southern Guinea savanna, about 300 km northeast of Lagos.

The state has an estimated population of 2 780 389 people and occupies a landmass of 30 955 km^2, giving a density of about 90 inhabitants/km^2. The population is dominated by the Tiv ethnic group whose social organization utilizes a simple principle of organization, the agnatic lineage structure based on the principle of segmentary opposition. The principle of patrilineal descent is dominant in the Tiv culture and permeates practically every institution. It forms the basis not only of the family and the household system, but also of the settlement pattern and political organization (Bohannan 1965). Tiv settlement patterns reveal villages of varying sizes and population distribution. The head of the family group has a certain amount of real authority. He usually (but not in all cases) coordinates the farming activities of the family group, though every adult male member

has a voice in this matter. Property, including animals, utensils, and crops, is regarded as being possessed in common, but is predominantly under the charge of the senior male member for the benefit of the whole community. However, the head of the family group has little control over food consumption, since most of the staple crops are in the hands of married women. The prevailing land-use system consists of crop mixtures; the most important crops are yam, cassava, sorghum, millet, soybean, rice, vegetables, groundnut, sweetpotatoes, and fruit trees such as mangoes and oranges.

Data collection and analysis

In order to provide a broad basis to the findings, several methods of data collection and analysis were used. Harris et al. (1995) claim that "understanding the economic and social forces shaping rural areas requires a variety of theoretical and methodological approaches. Combined ways of looking at social phenomenon afford the possibility of constructing a more complete picture of rural people and places." Thus, data collection involved a combination of household interviews, participatory rural appraisal (PRA), a food consumption survey, anthropometric measurements, and field observations.

SIA advocates participatory farmer assessment of technology and ensures that the views of farmers, as users and beneficiaries of technology, are considered, and in fact constitute the basis of impact assessment. A total of 16 focus group discussion (FGD) sessions were conducted, eight with 6–12 men and eight with 6–12 women. Discussions were tape-recorded and later transcribed. The second phase involved household and farm surveys. A 3-stage stratified sample of 203 households was selected in 24 rural communities in two local government areas—Gboko and Gwer—in the northern zone of Benue State. Representation of women with different characteristics (*de jure* and *de facto* household heads, women managing farms, and wives) was ensured. The set of interview schedules consisted of a general household questionnaire, a technology adoption and farmers' assessment questionnaire, a soybean utilization and food consumption questionnaire, and an anthropometric survey. Anthropometric data were collected by direct measurements of height and weight of 353 children aged 0–12 years.

Data analysis involved the use of appropriate qualitative and quantitative techniques. Qualitative analysis provided depth and complementary insights to quantitative analysis. It helped to capture and understand the richness of farmers' social experience, meanings, point of view, and their assessment of the real impact of soybean on their households and communities. The statistical analysis of data involved relevant descriptive and multivariate statistics. Tobit regression models were used in modeling the determinants of adoption and

intensity of use of improved varieties. Z scores of weight-for-age, weight-for-height, and height-for-age were used in assessing the impact of soybean on the nutritional status of children (WHO 1983; Braun and Kennedy 1994). Statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) (1994) while the Tobit models run was done with LIMDEP (Green 1992).

Results and discussion

Gender analysis in soybean production

A total of 203 households were surveyed; 37% of respondents were women and 63% were men. The mean age was 47.7 years for men and 41.7 years for women. A considerable proportion (29.8%) of women were either *de jure* (17.6%), or *de facto* (12.2%) household heads. In both cases, women were the effective farm managers. A considerable proportion of women (46%) and men (42.7%) had had no formal education, while 41.9% of women and 38% of men had attended primary school. The average household size was about 11 persons, ranging from 2 to 41 persons. The average number of years of farming experience was about 25 for male respondents and 23 for female respondents. The average number of years of experience in soybean production was 12.1 years for men and 8.4 years for women, with ranges between 0 and 50 years. The majority of male farmers (59%) had been growing soybean before the introduction of the improved varieties in the late 1980s, while the majority of women (55%) had started to grow soybean after the introduction of the improved varieties.

The analysis based on the division of responsibilities and tasks undertaken by men and women in soybean production distinguished four common alternative patterns of gender responsibilities. In the first pattern, soybean was considered as a man's cash crop, while women were confined to the production of food crops. In some cases, however, soybean was also considered as a woman's crop in households where men were engaged in the production of other cash crops such as tobacco, oranges, and rice, or had other off-farm activities. This concerned about 20% of women. In the second pattern, soybean was cultivated by both men and women, but on separate farms. About 62% of the women indicated that they had their separate soybean farms while 69% of male respondents indicated that their spouses had their personal soybean farms. In the third pattern, soybean production was a family enterprise (48% of men and 20% of women). In this pattern, men and women performed different but complementary tasks on the same plot. For instance, men provided labor for land preparation and for making ridges, while women were responsible for planting and weeding. Both men and women took part in harvesting and threshing. The last scenario concerns some 33% of women managing soybean farms without men's assistance, as independent decision-makers and effective farm managers.

The traditional gender division of agricultural activities in Tiv farm households is such that men are responsible for heavy tasks including land preparation while women take over the management of the farm after land preparation (Bohannan 1965; Burfisher and Horestein 1985). Survey results showed that 45% of the total family labor was provided by men, 29.1% by women, and 13.3% by children, while hired labor accounted for 13% of the total labor input in soybean production. Considering the fact that hired labor was essentially male, taken together, men contributed about 58% of the total labor input in soybean production compared to 29% contributed by women. Contrary to the widely quoted generalization that African women provide between 60 and 80% of labor input in agricultural production, we found that men, compared to women, contributed twice as much labor in soybean production. Similar findings were reported by Braun and Webb (1989) who showed that men, not women, provide the greater share of the total farm labor for rice production in The Gambia. These results suggest clearly that unguided generalizations about gender division of roles should be avoided. There are variations across cultures, periods, crops, and households.

Diffusion process of improved soybean varieties

The results of focus group discussion, farmers' interviews, key informants' interviews, and field validation showed that the different soybean varieties cultivated by farmers can be classified into three broad categories. The first group is the "local" variety called "Tiv soybean". Although called a local variety, this variety corresponds to the Malayan variety which was introduced from Malaysia to farmers in 1937 (Singh et al. 1987). In our survey we found that this variety had been completely displaced by new varieties in all 24 villages. No farmer indicated cultivating the variety, nor did they know anyone cultivating the variety in their village or other villages. The second group of varieties can be classified as "old improved varieties". These varieties became available in the early 1980s. Prominent among them are M351 (released in the early 1970s), Samsoy 1 and Samsoy 2 (released in the 1980s by the Department of Agriculture). Because these varieties emanated from the Department of Agriculture, farmers generally refer to them as "Agric", "Genyi", or "Gboho," referring to their larger size of grain.

The third group of varieties is classified as "new improved varieties". These varieties were introduced in the late 1980s and early 1990s by the Extension Department of the Benue State Agricultural and Rural Development Authority (BNARDA). Thus, farmers call these varieties "BNARDA". Included in this varietal group are the TGx series developed by IITA. Starting in the late 1980s, IITA introduced TGx 536-02D to farmers, followed by the release of the variety TGx 923-2E in 1993. In 1997, the most recent variety released, TGx 1440-1E, was still

in the phase of adaptive research and was not considered within the frame of this study. This study focused on only two varieties (TGx 536-02D and TGx 923-2E) that have been extensively diffused to farmers and for which the time lag between their introduction and adoption was long enough to justify an impact study.

The major method of introducing improved varieties to farmers was through the small plot adoption technique (SPAT). A SPAT is a farmer-implemented mini-demonstration plot to enable the farmer to compare the result of existing varieties with that of new varieties. The assumption of SPAT is that farmers are very likely to accept innovations if these have been successfully practiced under their conditions and if they are convinced of the advantages of the improved practices compared to their existing ones. BNARDA set a target of reaching 22 840 farmers for the introduction of improved varieties. However, between 1989 and 1995, about 14 846 farmers were reached, and about 11 134 contact farmers established a soybean plot after a SPAT trial of TGx 536-02D had been established in their farms. These satisfactory results led the extension services to stop the diffusion of TGx 536-02D because it had reached the stage of mass adoption and seed was widely available to farmers.

Rates of adoption of improved soybean varieties

Estimating the rates of adoption, that is, the proportion of farmers who use the technology over a period of time, is an essential step in assessing the impact of technology. Figure 1 shows the cumulative rates of adoption of the improved varieties by gender of the grower. The figure shows that early adopters were mainly men, with 5% of male farmers adopting the varieties even prior to their "formal" release by the extension service in 1989. Some of these early "innovators" (Rogers 1995) obtained the seed of the varieties from research stations or from other locations preceding the formal introduction of the varieties into their own regions. The number of male farmers adopting the varieties increased to 9% in 1989 and 16% in 1990. In 1993, 4 years after the formal introduction of the varieties, the rate of adoption increased rapidly, reaching 44% of male farmers and 36% of female farmers. One year later, the percentage of adopters had increased to 59% of men and 46% of women. The figures in 1996 were even more impressive, with 75% of male farmers and 62% of female farmers adopting the improved varieties. Significant differences exist in the varietal adoption rates between the two regions of study, with adoption levels being significantly higher in Gboko than in Gwer.

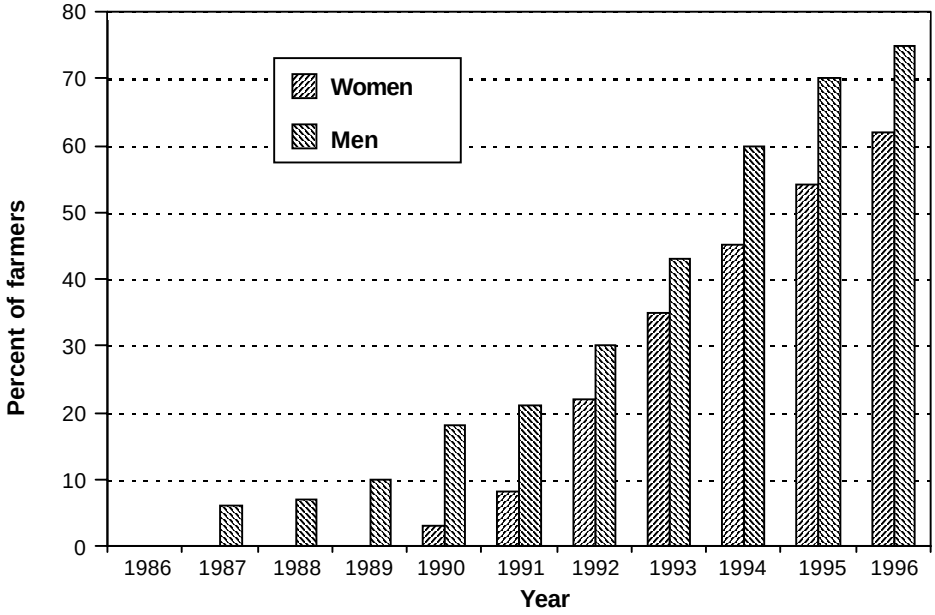

Figure 1. Rates of adoption of improved soybean varieties (TGx 536-02D and TGx 923-1E) by gender in Benue State (n = 129 for men and 74 for women).

Determinants of farmers' adoption of improved varieties

Analysis of the factors determining adoption is essential to discover what categories of farmers have benefited from the adoption of improved varieties, and to know what varietal characteristics motivated farmers to adopt or reject improved varieties. The empirical model used to assess these factors was made up of three variants of the Tobit model. These are probability models that have the ability to handle a binary dependent variable and multiple continuous and categorical variables in an econometric analysis. The first model integrates only farmers, household characteristics, and institutional variables; the second considers farmers' perceptions of varietal characteristics, and the third is a complete model that combines the first and second models (Sanginga 1998). Results of the three variants of the Tobit models are given in Table 1.

When only the socioeconomic variables were considered, four variables were significant in explaining the probability of adoption and use intensity (Model 1). Village location and expenditure in hiring labor were positively and significantly related to adoption of improved varieties of soybean while the gender of the farmers and farmers' age was negatively related to adoption. Among the technology characteristics (Model 2), farmers' assessment of maturity time, higher yields, and resistance to shattering were the most important attributes influencing farmers' adoption behavior and intensity of use of improved soybean varieties. In the complete model (Model 3), where all the variables were included in the analysis, seven variables were significant at between the 1% and 5% levels in explaining the adoption and use intensity of improved soybean varieties. These were the village location, gender of

Table 1. A Tobit model of the estimates of the socioeconomic and technology characteristic determinants of adoption of improved soybean varieties in Benue State, Nigeria

Variable	Expected sign	Model 1	Model 2	Model 3
Village location				
(Gboko = 1, Gwer = 0)	+	86.40***	–	66.166***
Gender of cultivator				
(male = 0, female = 1)	–	–25.122*	–	–32.305
Soybean experience (years)	+	0.502	–	0.86629
Contact with extension	+	–17.946	–	–28.342**
Farmer education	+	–6.361	–	–3.4776
Farmer age (years)	–	–1.816**	–	–1.5438***
Farm income	+	0.12006E-3	–	–0.16730E0-3
Hired labor (Naira)	+	0.3149E-2**	–	0.39322E0-2***
Household size	+	–0.3350	–	0.12974
Maturity time[a]	+	–	52.892**	30.633*
Yield[a]	+	–	107.56***	37.167***
Grain size[a]	+	–	–11.159	8.3955
Grain color[a]	+	–	6.4573	–13.542
Resistance to shattering[a]	+	–	14.935*	13.581
Constant		–14.300	–81.328***	–43.843
Log-likelihood function		–280.143	–292.226	–262.89

***Significant at 1% confidence level; **significant at 5% confidence level; *significant at 10% confidence level.
[a]1 = improved variety is better, 0 = otherwise.
Source: Adapted from Sanginga (1998).

the cultivators, age of the farmers, expenditure on hired labor, extension contacts, and two technology attributes variables, yield and maturity time.

The results show that village characteristics are important in influencing the adoption of improved soybean varieties. The higher adoption rate in Gboko is linked with better market access in this area than in Gwer. This result is very significant for efforts to promote soybean in Nigeria and other parts of Africa. To achieve high adoption rates of improved soybean varieties, such technologies should be targeted to areas with better opportunities for commercialization. The negative sign associated with the gender factor suggests that women farmers have a lower adoption probability and intensity of use of improved varieties than men farmers. This differential adoption based on gender can be explained by gender biases in technology diffusion and is corroborated by findings from other studies (Saito and Weidemann 1993; Quisumbing et al. 1995; Sanginga 1995; Sanginga 1998). Women farmers are not traditionally targeted by extension agents and research and development activities. Innovations are often introduced

to heads of households, the majority of whom are men. Thus, access to innovations or information on such innovations is more restricted for women than for men. The implication of this finding is that greater efforts will be needed to close the gender gap in access to, and use of, improved technology. This is important in view of the role of soybean in household food security and nutrition, and in improving soil fertility.

The results also revealed that older farmers have a lower adoption probability and use intensity of improved soybean varieties. Younger farmers tend to be more educated and innovative than older farmers, and may also have a lower level of risk averseness towards technology adoption. Thus, efforts to promote soybean should target younger farmers, who are increasingly becoming an important force in rural economies. The positive and significant sign associated with expenditure on hired labor suggests that this affects the adoption and intensity of use of improved varieties. This is intuitive, as adoption of new varieties affects labor use due to an expansion in the area cultivated and the intensity of crop management.

The result concerning contact with extension services was unexpected as many empirical findings have indicated that contact with extension services increases the probability of adoption as farmers become more aware of innovations. However, in a recent study of the adoption of tobacco varieties, Dimara and Skuras (1998) found that the number of contacts with the extension services had a negative effect on the probability of adoption. These results could be explained by a self-selection process by which the more risk-averse farmers seek more information. Yet, these results are not surprising since this study was an *ex post* impact assessment conducted about 8 years after the varieties had been introduced to farmers (Sanginga 1998). Contact with extension services may not have had much impact on farmers' adoption and use intensity of improved soybean varieties since farmer-to-farmer horizontal dissemination of information and seed was more important in the dynamics of technology diffusion. Survey results showed that only 22% of farmers obtained their first seed from the extension services. It is known that the farmer-to-farmer horizontal diffusion of improved seed is, in fact, very important in technology dissemination in small-scale farming systems (Grisley 1994; Sanginga 1998).

Among the technology-specific characteristics, the results show that farmers' perception of early maturity, high yields, and resistance to shattering were the three most important varietal attributes that motivated adoption of improved varieties. The estimated results show clearly that both farmers' circumstances and varietal characteristics strongly condition adoption decisions. In summary, male farmers of younger age, with more cash to expend on hired labor, better market access opportunities, but less contact with extension services have benefited more from improved soybean varieties.

Impact on household incomes

It was found that soybean was more profitable to farmers than other competing and companion crops in the farming system. Both the gross margin analysis and the benefit-cost ratio analysis showed higher returns to soybean production as a sole crop or when intercropped with sorghum. The gross margin from sole soybean and sole groundnut showed that it was twice as profitable for farm families to invest their labor in growing soybean rather than in growing groundnut under present yields and prices in Nigeria (Kormawa 1996).

The results of focus group discussions and household interviews corroborate these findings. The results of farmers' ordinal ranking of the relative importance of major crops revealed that soybean was ranked first as the most important source of cash income by 42% of men and 47% of women in 1997 (Fig. 2). There were significant village differences in the relative importance of crops as sources of income. While soybean was the common source of income that provided the largest share of farm income for the majority (68.8%) of farmers in Gboko, it provided the largest share of income for only 20% of farmers in Gwer, after rice.

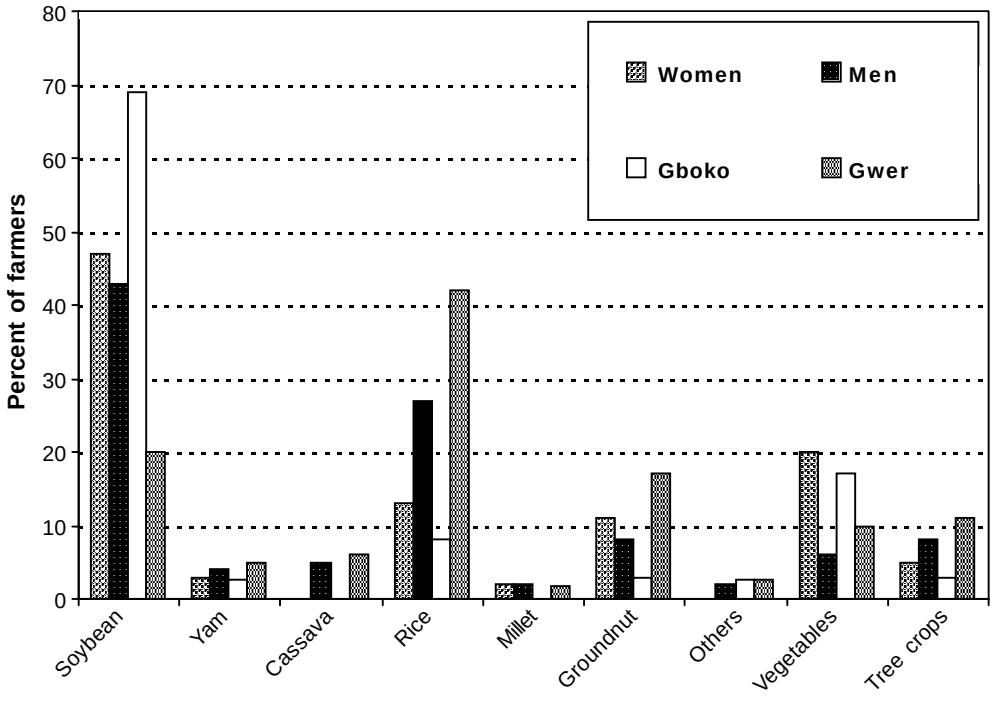

Figure 2. Distribution of households according to the most important source of income by gender and village location, Benue State, 1997 (n = 129 for men; 74 for women; 103 for Gboko; and 100 for Gwer).

Mean soybean cash income was N14 051 for men compared to N9156 for women. Farmers within Gboko obtained a higher income than farmers in Gwer, and men had a significantly higher income than women. Nevertheless, women in Gboko had a higher income than men in Gwer. Income from soybean often came in one lump-sum payment. Soybean grain was usually sold at once after threshing. In 1997, for instance, a bag of soybean (100 kg) was sold at N2000 ($25). A farmer in Gwer Local Government who earned up to N65 000 ($812) from soybean claimed proudly that "I got so much money from just one harvest of soybean."

In Gboko, men and women derived equally more than half (58%) of their total income from soybean, while in Gwer, women (23%) appeared to have a slightly higher proportion than men (20%). More than three out of five female and male farmers in Gboko earned more than half of their total farm income from soybean, compared to only one out of eight farmers in Gwer. On the average, soybean provided 44% of the total farm income for male soybean producers and 43% for female producers (Table 2).

The findings of this study showed that women earned a substantial proportion of their income from soybean, traditionally a male crop. This finding provides further empirical evidence that African women are actively involved in the cultivation of cash crops, and that they earn a substantial share of their income from the cultivation of marketed crops, such as soybean. Ethnographic data (Bohannan 1965) and survey results further showed that women have full control over their income in the Tiv society. Recent studies on intrahousehold allocation behavior have accumulated evidence that women's control of food production, and increases in the proportion of cash income accruing to women significantly contribute to

Table 2. Contribution of soybean to household income (Naira per year, 1996 harvest) and intrahousehold gender redistribution of soybean income in Benue State, Nigeria

	Gboko (high adoption area)		Gwer (low production area)		Totals		
	Men (n = 60)	Women (n = 43)	Men (n = 69)	Women (n = 31)	Men (n = 129)	Women (n = 74)	Total (n = 203)
Mean soybean income	23 351	13 374	5965	3306	14 051	9156	12 223
Proportion of soybean income relative to total farm income (%)	58.5	58.3	20.1	22.5	37.9	43.3	39.8
Mean soybean income redistributed*	2316	1253	1148	1012	1792	1165	1555
Percent of soybean income redistributed	21.1	18.8	27.8	23.0	22.6	20.7	21.3
Proportion of farmers (%) who redistributed soybean income	62.7	43.9	54.2	41.5	43.8	37.5	41.7

*Amount of money in Naira that the farmer gives to his wife or her husband from the sale of soybean; n = number of respondents.
Source: Sanginga (1998).

household food security, nutritional status, health, and welfare of children (Garcia 1991; Saito et al. 1994; Quisumbing et al. 1995; Hoddinott and Haddad 1995). The increased expansion of soybean under the control of women, and consequently the increased income generated from soybean production have led to the ability of women to improve their individual welfare, and the welfare of the household, as well as their bargaining power and economic independence within and across households (Sanginga 1998).

Impact on farmers' welfare

To assess the effects of soybean production on the welfare of farmers, we used the material style of life (MSL) and human capital investment (HCI) indices. The MSL index establishes a connection between the individual and the material world as expressed by the consumption of goods through which social status is acquired (Schoerder et al. 1985). Drawing from DeWalt et al. (1990), the MSL was based on the ownership of socially valued assets that were found in the household. In order to get more insight into the effects of soybean on the living conditions of households, respondents were asked to estimate changes in household assets, and the contribution of soybean to the acquisition of household assets and other valuable items.

Survey results show that the majority of farmers reported substantial increases in MSL items. Table 3 shows the percentage distribution of MSL/HCI items and the proportion of households that indicated that soybean had contributed in the acquisition of such items. It is also clear that soybean income contributed significantly to the acquisition of MSL items such as radios (48.4%), mattresses (71.9%), bicycles (27.7%), livestock (58%), and metal-roofed houses (14%) for men. Women reported similar investments, although notable differences existed. The majority of women seemed to spend more of their soybean income on HCI items for themselves and their children, paying school fees (89.7%), medical bills (45.9%), buying high-value food such as condiments and meat/fish, and other household items (67%). Other areas included contributions for the burial of kin group members and the performance of other social ceremonies and obligations.

In focus group discussion sessions, as well as in individual interviews, when farmers were asked about what achievements they had made with soybean income, the following represents how farmers assessed the impact of soybean on their household welfare:

> "... Soybean is my husband because it gives me money to take care of my problems, to pay my children's school fees, and hospital bills. I plant soybean to have money. Sometimes I can harvest up to 10 bags or more. Then I sell some and keep some for my daughter who is in the college at Yandev. When she comes

Table 3. Contribution of soybean income in the acqusition of MSL/HCI items in Benue State, Nigeria (% of farmers)

	Men (n = 129)	Women (n = 74)
Material style of life (MSL) items		
Radios	48.4	21.0
Goats	57.8	51.3
Metal-roofed house	14.1	12.6
Mattresses	71.9	64.1
Bicycles	27.7	5.2
Sheep	17.2	12.2
Pigs	23.4	12.8
Other assets	32.8	35.5
Human capital investment (HCI)		
School	76.6	89.7
Health	27.1	45.9
Marriage	30.6	–
Burials	22.5	14.5
Social obligations	41.3	18.1
Clothing	11.8	22.5
Others	84.4	66.7

n = number of respondents.
Source: Sanginga (1998).

home we sell some bags and she uses the money to buy her books and pay her school fees. She will get a good husband in town because men nowadays don't want to marry illiterate women… I have also bought many other things that most people would like to have… You see why I said soybean is my husband. I can't stop it for anything else. How can you leave your husband..." *(A female farmer in Abetse Village, Benue State)*

"I have achieved a lot with soybean. Any Tiv man would like to build a zinc house in his compound. Three years ago, my house was burnt by fire during the harmattan season. I lost everything I had... I cultivated more than 100 lines of soybean in three different places. I got enough money just from one harvest of soybean! I put a zinc roof on my house. I also bought a big radio cassette, mattresses, and many other things. Now I can keep my valuables in my zinc house and no fire will destroy them" *(A male farmer in Andoor village, Benue State)*

"...In our Tiv culture you need to marry more than one wife to look after your farm work. I married my second wife with the money I got from my soybean farm. Now my wives are complaining that my farm work is too much for them. Now

I need more hands for my farm work. This year, I will sell all my soybean to pay bridewealth for a new wife. It is only soybean that can give you enough money to satisfy your need..." *(A male farmer in Kyado village)*

"I can harvest between 2 to 3 bags, and sometimes 4 or 5. I normally sell part of my soybean before Christmas and I keep some to sell later when I need money or when there is hunger around June. Last year [1996 season] I sold two bags of soybean. I bought one nice wrapper for my mother, one for myself, and clothes for my children. I have also bought one goat, and I can count now up to 8–10 goats... No husband can give you all this money at once. I don't disturb my husband to buy me clothes, body cream, soap or to buy soup [meat/fish] and other things that I need. I get my money from soybean because if I sell only one bag of soybean, I have up to N2000. This is okay for me." *(A female farmer in Mbalav-Aliade village)*

In general, there was agreement among farmers that with soybean production, households have been able to improve their material welfare and their standard of living, as well as increase expectations. In addition to the material benefits derived from soybean production, farmers underlined the important role of soybean income in human capital development, as it relates to children's school fees, health care, hospital bills, and other social obligations.

Impact on household food security

Although the Tiv had grown soybean for a long time, people were prevented and discouraged from consuming it. It was believed that soybean was poisonous, and could cause sterility and blindness. From 1980 onwards, a number of soybean products were found to be acceptable and adapted to local diets. These were recommended and introduced to people. Results from our survey showed that virtually all farmers were aware of the utilization of soybean in the local diet. The rates of adoption of soybean utilization innovations ranged from 98.7 to 6.4% for the 12 innovations considered in the study. Among the recommended uses of soybean, the common soybean-based foods included *dadawa* (*nune*), *moinmoin* (*akpupa* or local bread), and *akara* (*akwese*). Soybean *dadawa* or *nune*, the fermented bean flavoring, is a substitute for locust beans in daily cooking. It was used by virtually all the farmers in the area. Soybean *moinmoin* (*akpupa*), steamed soybean cakes, were used by about 9 farmers out of 10. Similarly, *akara* (*akwese*), fried bean cakes, a snack made from soybean, was adopted by about 60% of farmer households. In contrast, soymilk was used by only about 25% of the households, although many farmers had heard of it. Similarly, soybean utilization innovations such as soycheese, soyvegetable soup, and soyflour were not commonly used by the majority of households. The most important constraints to the adoption of soybean innovations relate to the lack of awareness of processing methods

and other processing difficulties (Sanginga 1998).

The average quantity of soybean consumed in farmers' households was 2.5 kg weekly in January and February after harvesting, but it decreased to an average of 1.5 kg weekly in June during the planting season. Average per capita consumption of soybean was about 0.25 kg per person weekly, ranging from 0 to 3.5 kg. Figure 3 compares the pattern of soybean consumption and other food products over a period of 6 months (January–June) using the percentages of households reported to consume the product, at least once a week. The results show that the majority of households (94%) consumed soybean regularly in January and February. However, the percentage of households consuming soybean decreased slightly towards the planting period, but was still above 50% of the households at any time, and more importantly above the consumption of other protein-rich food such as meat/fish and cowpea. The second food product most frequently consumed by households in the survey area is meat. The major source of animal protein was bush rats hunted during the dry season. In January, this meat was generally available and the majority of households (62%) consumed meat regularly (almost every other day). Consumption of meat decreased dramatically to only about 18% of households during the planting season. Cowpea consumption was also limited to some 34% of households in January, and further decreased to about 19% in June. Household consumption of rice was rather very limited, despite the fact that the majority of farmers produced rice, especially in Gwer.

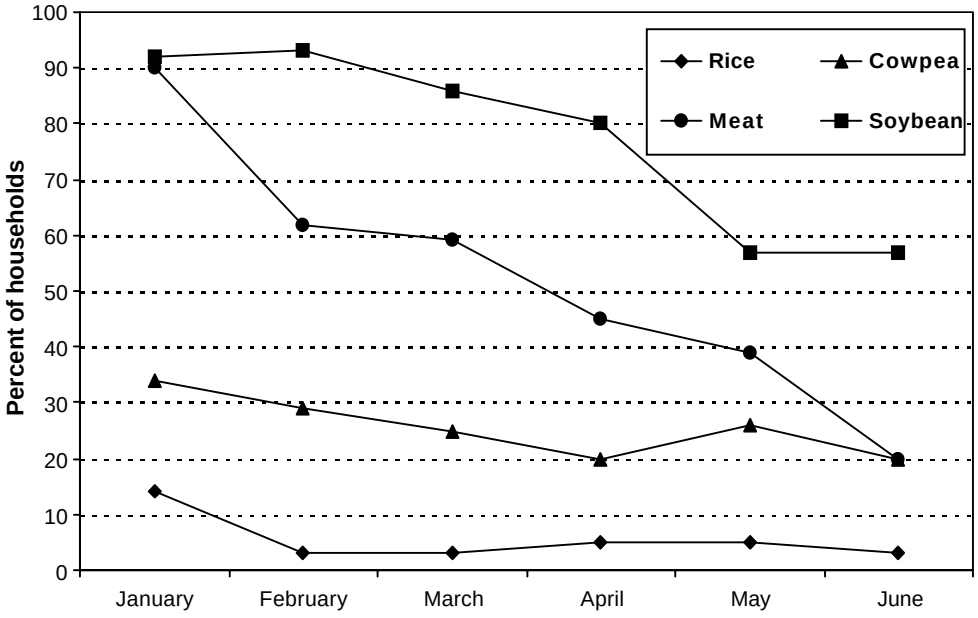

Figure 3. Proportion of Tiv households in Benue State that consume these food products at least once a week (January–June 1997) (n = 203).

The above results are markedly different from previous studies which estimated that household consumption of soybean was rather limited (Weingartner 1987; Woodworth et al. 1992; Atala et al. 1992) and clearly provide evidence that soybean has been integrated in the diets of the Tiv farmers of central Nigeria. This has important implications for household food security and nutritional status because soybean is a cheap, protein-rich crop.

Impact on the nutritional status of children

The impact of soybean on the nutritional status of children was assessed using anthropometric measurements of 353 children (186 boys and 167 girls) aged 0–12 years. About 43% of the children were preschoolers (0–5 years) and 57% were aged between 6 and 12 years. In general, the anthropometric indices showed a low prevalence of malnutrition among the children sampled. The majority of children fall within the normal Z scores values (below –2SD). The mean Z score values for weight-for-age and height-for-age show that the nutritional status of children in soybean-producing/using households appeared to be significantly higher than those of children in households that did not produce/use soybean (Table 4). No significant differences exist for height-for-age. It should be noted, however, that the nutritional status of children is determined by a complex interaction of several factors. To estimate the determinants of the nutritional status of children, three regression models (Table 5) were estimated using the individual child's Z score values of weight-for-age, height-for-age, and weight-for-height as dependent variables, and a range of individual child characteristics (age, sex, morbidity), household characteristics (household size, mother's age, education, income, village location), and soybean-related variables (quantity consumed, women's production of soybean, soybean cash income) as independent variables (for details, see Sanginga 1998).

The results of the three regression models show clearly that, besides the child's demographic characteristics (age, sex, morbidity), the soybean-related variables play a significant role in the improvement of the nutritional status of children. Household consumption of soybean measured as the per capita quantity (kg) of soybean consumed in 2 weeks, was positively and significantly related both to the long-term nutritional status of children and household food security (height-for-age) as well as to the short-term measure of children's nutritional status (weight-for-height) at the 5% confidence level. Considering that soybean contains high quality protein, the incorporation of soybean in local diets would improve their protein content, and consequently improve the nutritional status of household members. Nutrient intake studies have reported that soybean accounted for about 34.4% of the protein intake of children in northern Nigeria (Owolabi et al.

Table 4. Nutritional status of children in soybean-producing households and in no-soybean-producing households in Benue State (January 1997)

Nutritional index	Mean Z scores*		t value	Significance level
	Soybean-using households	No-soybean-producing/using households		
Weight-for-age	–0.083	–0.144	3.89	0.002
Height-for-age	–0.045	–0.668	2.56	0.011
Weight-for-height	0.006	0.004	0.10	0.273

International standards: *Z > –1.00: normal, –1.00 > Z > –2.00: mild malnutrition, –2.00 > Z > –3.00: moderate malnutrition, Z < –3.00: severe malnutrition.
Source: Sanginga (1998).

1996). The results of their study also showed that communities that produced and consumed soybean had a significantly higher percentage of nutritionally normal and a lower percentage of severely malnourished children than communities that did not produce soybean.

It is interesting to note that women's control of soybean production was significantly related to the long-term nutritional status and household food security of children (weight-for-age) at the 1% confidence level, and to children's height-for-age at the 5% confidence level. The implication of this finding is that increasing women's production of soybean has robust effects on the long-term food security and better nutritional status for children. Women's control of soybean production is associated with household consumption of soybean which, in turn, improves the nutritional status of children. The results also show that soybean income, that is, the amount of cash income earned from the sale of soybean, is positively and significantly related to weight-for-height measurements.

These results provide empirical evidence confirming that household production and consumption of soybean contribute significantly to improving the nutritional status of children. These results were further confirmed by farmers' assessment. Virtually all farmers reported the nutritional benefits of soybean. In farmers' opinion "soybean adds blood" and "soybean makes children look fresh".

Impact on use and allocation of resources

Labor is the most important resource in the Tiv farming system. Labor availability places a limit on the size of land a household can cultivate, and on the ability of certain categories of farmers to adopt and benefit from improved technologies. It also determines the differential impact of soybean on different types of households. Burfisher and Horestein (1985) found that in the Tiv farming system, the

Table 5. Estimates of the determinants of the nutritional status of children in Gboko and Gwer local government areas of Benue State in January–February 1997 (Y = individual child's Z score value)

Variable	Weight-for-age		Height-for-age		Weight-for-height	
	Coefficient	t ratio	Coefficient	t ratio	Coefficient	t ratio
Constant	–0.49016E-01	–0.820	–0.45212E-01	–1.372	0.79210E-01	0.988
Child age	–0.13670E-01	–5.267***	–0.36670E-02	–2.568***	–0.90901E-02	–2.633***
Child sex (1 = female)	0.51559E-01	3.25***	0.14196E-01	1.68*	0.62822	0.296
Sickness	–0.12130E-01	–2.355***	–0.47409E-02	–1.658*	–0.59895E-02	–0.865
Income	–0.21679E-03	–1.429	–0.97128E-04	–1.80	–0.46412E-05	–0.023
Mother's age	0.56624E-03	0.621	0.94823E-03	1.908**	–0.86752E-03	–0.716
Village location	–0.27171E-01	–1.382	–0.47409E-02	–0.339	–0.44434E-01	–1.694*
Soybean income	0.78445E-06	1.162	–0.25183E-04	–0695	0.17103E-05	1.905**
Meat consumption	0.24184E-02	0.727	0.13049E-02	0.717	0.88152E-02	1.992**
Women's control of soybean	0.50094E-01	2.666***	0.22598E-01	2.202**	0.22249E-01	0.887
Dependency ratio	–0.15335E	–0.440	–0.34180E-01	–1.782*	0.30146E-02	0.647
Mother's education	0.20813E-02	0.100	–0.18523E-02	–0.162	0.17526E-02	0.063
Soybean consumption	–0.56024E-02	–0.610	0.81376	1.608**	0.23976E-01	1.961**
R^2	0.17		0.11		0.78	
Adjusted R^2	0.14		0.07		0.41	
n	353		350		350	

***Significant at 1% confidence level, **significant at 5% confidence level, *significant at 10% confidence level; n = number of children.
Source: Sanginga (1998).

problem of labor availability and seasonality is also exacerbated by gender role differences, and could adversely affect the timeliness of critical operations.

The results showed that the adoption of early maturing varieties has led to a degree of flexibility in the allocation of labor, in deciding upon the time for land preparation, planting, and harvesting. The latter aspect is critical to avoid pod shattering, a major constraint in soybean production. This flexibility also allows farmers to avoid competition for labor with other food crops. In these circumstances, it was possible for resource-poor farmers, especially women, to benefit from the system of labor pooling and sharing, family labor, and hired labor for land preparation. The fact that these varieties could be planted late from July to early August and still give a good yield has led farmers to intensify land cultivation through double cropping practices. While in the traditional cropping system, it was possible to obtain only one harvest per unit of land per cropping season, early maturing varieties provided opportunities to plant a second crop directly after harvesting groundnut, tomatoes, millet, and tobacco on the same land during a cropping season. There was no doubt in the opinion of farmers that this practice of double cropping with soybean was economically and socially profitable.

Farm level impact

This section considers the impact of the improved varieties on farmers' fields. The results in Table 6 show that the average land area planted to soybean was 2.18 ha with the range between 0.16 ha and 6.76 ha for men, and 1.31 ha ranging between 0.18 ha and 4.31 ha for women. In Gboko, the mean farm size was 2.18 ha per farmer compared to 1.24 ha in Gwer. These results are markedly different from those of Woodworth et al. (1992), who reported an average size of 1.1 ha in Gboko and 0.5 ha in areas further from Gboko. This shows that farmers have been increasing the area cultivated to soybean since the late 1980s.

While previous studies have argued that the expansion of soybean in Nigeria was due to the effects of macro-policy shifts (Smith et al. 1995), the results of this study suggest that technological change as evidenced by the introduction of improved soybean varieties and processing technologies was also critical. The mean soybean farm size under improved varieties was 0.95 ha for men and 0.40 ha for women. Similarly, the proportion of land area under improved varieties was 36.3% for men and 21.4% for women. While improved varieties occupied 42% of land area for soybean cultivation in Gboko, they occupied less than 10% in Gwer. When adopters alone are considered, the intensity of adoption of improved varieties as a share of total soybean area is even more marked ranging from 55% (1.5 ha) for male farmers to 50% (1 ha) for female farmers. These results clearly show that not only has there been a rapid growth in diffusion of improved varieties, but

the level of use intensity on soybean fields has also increased significantly. The results of a regression analysis (OLS) further confirmed that the adoption of improved varieties was positively and significantly related with the total area under soybean cultivation. Thus, technological change, such as the introduction of improved varieties, was essential in the expansion of soybean in Nigeria (Sanginga 1998). This is similar to the significant development recorded in maize production in northern Nigeria due to the introduction of improved varieties (Smith et al. 1994).

The results of the farmers' assessment of the benefits of improved varieties (Table 7) indicated that improved varieties were better than other varieties in terms of maturity time (85.5%), high yields (63.8%), performance under poor soil conditions (61.6%), extent of branching (45.6%), and ease of harvesting (45.6%). The results of the small plot adoption techniques (SPAT) established in farmers' fields showed that improved varieties produced on the average 42% more grain yield than other common varieties found in the area (BNARDA 1995). An additional advantage of the varieties, as perceived by farmers, was their ability to give a good yield without fertilizer application. This was important in the situation where fertilizer is not easily accessible to small-scale farmers. Yet, local varieties were assessed better than improved varieties by 84% of farmers in terms of grain color and by 68% in terms of grain size. Farmers complained about the greenish color of certain seed (especially when planted late), the small size of the grain, and the light weight of grain which make the variety less desirable in the market than the variety M351. It is therefore important that future research should give attention to grain size and color in developing new varieties of soybean.

It has been argued that the expansion of cash crops in small-scale agriculture has negative effects on the production of basic staple food as land, capital, and labor are shifted away from these crops (Braun and Kennedy 1994). The land allocated to soybean was not at the expense of that for basic staple food. Rather soybean was intercropped with sorghum, one of the most important staple food crops among the Tiv. It was the general belief of farmers in this area that "soybean gives sorghum". Given the importance of sorghum as a second staple food after yam in this area, the expansion of soybean had a positive effect on food security as it allowed farmers to expand their sorghum production. The average farmer harvested 12.3 bags (1230 kg) of soybean [ranging from 0 to 75 bags (7500 kg)] and 4 bags (400 kg) of sorghum. The average soybean yields were estimated at 9.2 bags/ha (920 kg/ha) and 7.4 bags/ha (740 kg/ha) for men and women, respectively.

On the negative side, the lack of appropriate resource and crop management strategies for sustainable production continues to be problematic for the majority of farmers. Although they were well aware of the ability of soybean to improve

Table 6. Average soybean farm size, area, and proportion of land area under improved varieties by gender and village location in Benue State, Nigeria in the 1997 cropping season (per household)

	Gboko			Gwer			Total		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
	(n = 60)	(n = 42)	(n = 123)	(n = 69)	(n = 31)	(n = 100)	(n = 129)	(n = 74)	(n = 203)
Area cultivated to soybean (ha)	2.61	1.58	2.18	1.75	0.69	1.33	2.18	1.24	1.82
	(1.58)	(1.19)	(1.61)	(1.78)	(0.52)	(1.52)	(1.84)	(1.10)	(1.61)
Land area under improved varieties (ha)	1.15	0.64	0.95	0.61	0.02	0.39	0.91	0.45	0.71
	(0.83)	(0.88)	(0.89)	(1.36)	(0.07)	(0.10)	(1.10)	(0.78)	(0.99)
Proportion of land area under improved varieties (%)	47.5	31.5	42.1	14.10	1.81	9.55	33.05	22.45	28.26
	(29.4)	(35.6)	(33.2)	(29.6)	(5.4)	(24.1)	(33.4)	(33.6)	(33.3)

Note: Figures in parentheses are standard deviation of the mean; n = number of respondents.
Source: Sanginga (1998).

Table 7. Percentage distribution of farmers' assessment of the benefits of improved soybean varieties in Benue State, Nigeria in 1996

Varietal attribute	0	1	2	3
Extent of branching	5.9	5.9	42.6	45.6
Ease of harvesting	5.9	4.4	44.1	45.6
Maturity time	0	0	14.5	85.5
Performance under poor soil	6.5	1.6	30.3	61.6
Resistance to pests	6.5	8.1	69.4	16.1
Resistance to shattering	4.8	20.8	43.5	30.8
Grain size	0	67.9	32.1	0
Grain color	0	84.4	15.6	0
Ease of threshing	4.8	3.2	49.2	42.9
Yields	4.8	10.4	20.9	63.8
Soil improvement ability	4.8	1.6	74.2	19.4
General assessment	3.6	52.1	16.3	27.9

1 = M351 is better, 2 = no difference between M351, the most popular soybean variety, and improved varieties (TGx 536-02D and TGx 923-1E), while 3 = improved varieties are better. 0 = do not know or no response.
Source: Sanginga (1998).

soil fertility, results showed that full advantage is not taken of soybean as a nitrogen-fixing legume for improving soil fertility. Continuous cultivation of soybean for more than 3 years was recorded for a considerable number of farmers, and soybean residues were not left on, or returned to, the fields. The absence of crop rotation, and the burning of soybean residues after harvesting and threshing rather than returning them to the soil, will lead to nutrient mining and soil degradation.

Community level impacts

One of the most important indicators of social change is the introduction of new attitudes, values, and beliefs within the society and the family. As noted earlier, although the Tiv grew soybean for a long time, people were prevented and discouraged from consuming it. Results of FGD sessions and household interviews showed evidence of changes in these beliefs and attitudes. Tiv farmers have developed positive attitudes towards the value of soybean, not only as a cash crop but also as a food crop for household consumption. Claims such as "soybean adds blood", "soybean makes one look fresh", "soybean reduces hunger", "soybean flavors soup", and "soybean is very good for children" were common in FGD sessions and household interviews. Soybean has been therefore well integrated into the local diet of the Tiv.

Soybean production was also perceived as contributing to social status enhancement and providing a means for vertical social mobility for farmers: “There is no way a man can live in our village without planting soybean. People will look at you as a woman if you have a small soybean farm”. However, the status of the crop has changed over the years. From a traditionally male-dominated, market-oriented export crop, soybean has become one of the two most important crops grown by both male and female farmers for income generation and for household consumption. With the increased profitability of soybean, the introduction of improved varieties and utilization innovations, more and more women have become involved in soybean production, and in most important decisions affecting soybean production as well as in the control of income earned from soybean.

The expansion of soybean has broadened income opportunities for farmers, and people have become more mobile in their choice of markets. Markets serve not only as places for the exchange of the goods but also have other important purposes. They form a hub in communication networks since people meet at market places. The markets are also places where people have recreation and leisure. The expansion of soybean has had substantial effects on the demand for hired labor. Hired labor seems to have taken the place of group labor pooling and sharing, and the contract has become more monetized rather than social. However, the increased demand for hired labor has had effects on the incomes of poor households as they have gained by working for others. Hence, soybean expansion has led to redistribution of income over a large number of people in rural areas.

Conclusions

This paper used the SIA framework based on the technology diagnostic-diffusion-adoption-impact continuum to assess the actual impacts of soybean on the lives of resource-poor farmers in Benue State, Nigeria. The paper examined the social organization of soybean production, as it relates to gender roles and responsibilities and found that soybean was compatible with the farmers’ available resources and needs. The analysis showed that men provided twice as much labor as women in soybean production. This finding is in line with the results of some recent case studies in African agriculture which also show that there is an increasing male dominance of agricultural activities, including food crops (Braun and Webb 1989; Gladwin 1997). However, in this study, it was found that more and more women were increasingly switching to soybean production, a traditional male crop, as the crop became more lucrative and improved varieties were more readily available. Therefore it is argued that generalizations about gender roles should be avoided. There exists much diversity across cultures, across communities, and even across crops. Gender roles are not

static, but are responsive to changes in the farming systems, such as the introduction of improved technologies.

The results showed that improved varieties were widely adopted by farmers. The rates of adoption ranged from 9% in 1989 to 75% in 1997, about 8 years after their formal introduction. The area under soybean production expanded rapidly. Improved varieties accounted for about one-third of the total area cultivated to soybean, and over one-half among the adopters. The results of the Tobit model showed that farmers' socioeconomic circumstances and farmers' perceptions of varietal attributes were important in shaping farmers' adoption behavior.

The study provides evidence that soybean production had a positive impact on farmers' income accounting for about half of the total farm income for men as well as women. Hence, women's involvement in soybean production broadened equity and distributional effects as it was recognized that income in the hands of women contributed more to household welfare, food security, and children's nutritional status. The production of soybean had positive effects on farmers' material welfare and investment in human capital development such as children's education, health care, social networks, and the enhancement of social status. Soybean also became integrated in the daily diet of the majority of farmers and is in fact rapidly becoming a food staple among the Tiv.

The anthropometric measurements of children showed evidence of the improvement in the nutritional status of children in soybean producing and using households. The results of multivariate analysis clearly showed that, besides the child demographic variables (gender, age, and morbidity), the most significant determinants of the nutritional status of children were per capita soybean consumption, and women's production of soybean. It is therefore clear that the expansion of soybean production under women's control, and the promotion of household utilization methods, can be essential in efforts to alleviate malnutrition.

When the pressing needs to alleviate poverty and malnutrition and to improve the welfare of resource-poor farmers in sub-Saharan Africa are considered, issues relating to high quality protein food, greater income opportunities for male and female farmers, and soil fertility improvement are of paramount importance. From this case study, there is evidence that soybean contributes positively to each of these areas. There is, therefore, great potential for soybean to achieve a positive social impact on farm households, improving their economic basis, gender relations, and social equity, and nutritional status and welfare within and across households in other areas of Nigeria and sub-Saharan Africa. This paper argues for the need to move beyond the past focus of predicting potential impact based on economic data alone towards a more empirical and comprehensive assessment of the actual impact of agricultural technologies on farmers' welfare and other social

processes in the community. More work is still needed in this area to ascertain the direct and indirect impact of agricultural technologies on the lives of resource-poor farmers in sub-Saharan Africa.

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Ibadan, Nigeria . International Institute of Tropical Agriculture, (c)1999. Physical Description: 32 p. : ill. ;, 26 cm. Series Statement: Impact / International Institute of Tropical Agriculture. Bibliography, etc. NoteÂ by Ellen Ernst Kossek and Brenda A. Lautsch. ISBN: 013234999X ISBN: 9780132349994 Author: Kossek, Ellen Ernst. This study examines the effects of traditional sedentary grazing on soils in the southern guinea savanna ecosystem in Nigeria. The characteristics of soil in grazed plots are compared with those of similar soil in ungrazed plots in a savanna â€˜forestâ€™ reserve in a nearby locality, in order to infer the effects of grazing. In the 0â€“10 cm layer of the soil, organic carbon, total nitrogen, exchangeable calcium, magnesium, potassium, sodium, cation exchange capacity and available phosphorus levels are significantly lower in the grazed plots. Decline in the organic carbon and nutrient